Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge
Quarterly Update Report – April 2009

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Overview

This update is a summary of activities since the previous status report of January 2009 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: http://sofia.usgs.gov/lox_monitor_model/. The primary objective of this overall program focuses on providing information for use in ecological management of the Refuge (Brandt et al. 2004; Harwell et al. 2005; USFWS 2007a, b).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

> ***B. Enhancing Monitoring of the Refuge***
> *Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

The Refuge's modeling component of this program also addresses several of the Consent Decree Principals recommendations (17 December 2003):

> ***C. Modeling of the Refuge***
> *1. Develop a water quality/hydraulic model for the Refuge with a phosphorus cycling component.*
> *2. Evaluate issues associated with phosphorus loads and transports within the L-40 and L-7 canals.*
> *3. Develop and track a simple phosphorus mass-balance model for the Refuge.*

Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: http://sofia.usgs.gov/lox_monitor_model/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at http://www.sfwmd.gov/org/ema/dbhydro/index.html. Data for June 2006-March 2009 are posted on the Technical Oversight Committee's web site at https://my.sfwmd.gov/portal/page?_pageid=2235,4688652,2235_4688399&_dad=portal&_schema=PORTAL. This report includes information from samples collected through March 2009.

Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and continued work on data analyses for the 4th Annual Report.

Monitoring Update (January 2009 – March 2009)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 31 stations in January 2009, 23 stations in February 2009, and 10 stations in March 2009 (**Table 1**).

Total phosphorus data available to date for April 2008 to March 2008 are presented in **Table 1**. Maps of stations where samples were collected for January 2009 through March 2009 are presented in **Figures 2-4**.

Conductivity sonde deployment information for April 2008 to March 2008 is presented in **Table 2**.

Modeling Update

During the first quarter of 2009, the Refuge modeling team continued focus on completing models as publicly-available versions in advance of a May 2009 modeling workshop with the public and technical review panel. Efforts continued on documentation of model use and appropriate application.

Next Steps

The next steps for this program include completion of the next Annual Reporting, a modeling workshop in May 2009, and additional model development and application.

References

http://sofia.usgs.gov/lox_monitor_model/

Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.

Harwell, M. Surratt, D., Waldon, M., Walker, B., Brandt, L. (2005) A.R.M. Loxahatchee National Wildlife Refuge Enhanced Water Quality Monitoring and Modeling Interim Report. April, 2005. 106 pp.

USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.

USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.

Table 1. Total phosphorus data (ppb) available for April 2008 – March 2008 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations is shown in Figure 1.

a) Marsh stations

	Marsh Station	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09
A101	LOXA101	-	-	-	7	8	11	14	3	10	9	3	-
A102	LOXA102	-	-	-	U	7	7	15	3	28	10	-	-
A103	LOXA103	-	-	-	U	11	8	16	3	15	11	-	-
A105	LOXA105	-	-	-	3	18	14	17	11	10	9	3	-
A106	LOXA106	-	-	-	U	12	8	14	7	10	-	-	-
A107	LOXA107	-	-	-	-	7	6	10	7	4	-	-	-
A108	LOXA108	-	-	-	U	6	5	9	3	13	-	-	-
A109	LOXA109	18	-	-	U	8	11	13	7	7	9	3	-
A110	LOXA110	-	-	-	-	6	7	10	7	3	3	-	-
A111	LOXA111	3	-	-	U	3	9	10	3	6	6	-	-
A112	LOXA112	6	-	-	U	8	21	12	7	8	8	3	-
A113	LOXA113	14	-	-	U	4	4	7	7	5	3	-	-
A114	LOXA114	6	-	-	U	5	7	10	3	7	5	3	-
A116	LOXA116	69	X	X	X	X	X	X	X	X	X	X	X
A117	LOXA117	-	-	-	11	12	18	24	9	10	8	3	-
A118	LOXA118	6	-	11	4	8	10	15	8	10	9	3	U
A119	LOXA119	6	-	7	4	3	7	10	3	6	9	3	4
A120	LOXA120	7	100	5	4	3	5	6	3	3	30	3	3
A121	LOXA121	X	X	X	X	X	X	X	X	X	X	X	X
A122	LOXA122	14	-	-	U	12	15	15	6	7	62	3	-
A123	LOXA123	X	X	X	X	X	X	X	X	X	X	X	X
A124	LOXA124	4	-	-	U	7	20	18	3	5	4	3	13
A126	LOXA126	8	-	-	7	3	6	11	3	4	12	3	-
A127	LOXA127	4	-	-	5	3	5	11	3	3	-	-	-
A128	LOXA128	4	-	-	5	3	8	7	3	3	3	-	-
A130	LOXA130	10	-	16	9	10	7	16	10	13	7	3	-
A131	LOXA131	7	-	-	21	5	3	7	3	8	7	3	-
A133	LOXA133	-	-	-	-	38	19	31	18	21	-	-	-
A134	LOXA134	10	-	-	10	9	10	15	8	12	11	3	-
A136	LOXA136	-	-	-	26	16	21	64	9	14	9	3	-
A137	LOXA137	13	-	-	U	10	14	17	3	10	16	3	-
A138	LOXA138	8	-	-	U	8	15	9	3	5	17	-	-
A139	LOXA139	-	-	-	U	7	14	12	3	11	-	-	-
A140	LOXA140	-	-	-	U	10	3	10	3	12	9	-	-
A141	LOXA141	8	-	-	8	4	13	12	6	6	8	3	U
	MAX	69	100	16	26	38	21	64	18	28	62	3	13
	MIN	3	100	5	3	3	3	6	3	3	3	3	3

U indicates that compound was analyzed but not detected.

X indicates station no longer sampled.

Table 1 cont.

b) Canal stations

	Canal Station	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09
A104	LOXA104	24	44	54	32	36	36	33	34	26	22	10	32
A115	LOXA115	18	26	33	31	46	36	33	23	12	20	4	25
A129	LOXA129	34	49	37	23	52	34	42	21	19	11	21	40
A132	LOXA132	29	40	31	20	56	35	48	24	22	12	24	37
A135	LOXA135	32	40	26	13	65	54	49	13	22	14	21	42
	MAX	34	49	54	32	65	54	49	34	26	22	24	42
	MIN	18	26	26	13	36	34	33	13	12	11	4	25

U indicates that compound was analyzed but not detected.

Table 2. April 2008 – March 2009 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations is shown in Figure 1.

	2008									2009		
Site ID	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
LOXA104	X	X	X	X	X	X	X	X	X	X	X	X
LOXA105		X		X		X		X		X		X
LOXA106		X		X		X		X		X		X
LOXA107		X		X		X		X		X		X
LOXA108		X		X		X		X		X		X
LOXA111	X		X		X		X		X		X	
LOXA112	X		X		X		X		X		X	
LOXA113	X		X		X		X		X		X	
LOXA114	X		X		X		X		X		X	
LOXA115	X	X	X	X	X	X	X	X	X	X	X	X
LOXA116								X	X		X	X
LOXA117								X	X		X	X
LOXA118								X	X		X	X
LOXA119								X	X		X	X
LOXA120								X	X		X	X
LOXA126	X		X		X		X		X		X	
LOXA127	X		X		X		X		X		X	
LOXA128	X		X		X		X		X		X	
LOXA129	X	X	X	X	X	X	X	X	X	X	X	X
LOXA130		X		X		X		X		X		X
LOXA131		X		X		X		X		X		X
LOXA132	X	X	X	X	X	X	X	X	X	X	X	X
LOXA133		X		X		X		X		X		X
LOXA135	X	X	X	X	X	X	X	X	X	X	X	X
LOXA136		X		X		X		X		X		X
LOXA137		X		X		X		X		X		X
LOXA138		X		X		X		X		X		X
LOXA139		X		X		X		X		X		X
LOXA141								X				
LOXA142	X			X					X	X	X	X
LOXA143	X		X		X		X		X		X	
LOXA144	X		X		X		X		X		X	
LOXA145	X		X		X		X		X		X	
LOXA146	X		X		X		X		X		X	
LOXA147		X		X				X	X	X	X	X
LOXA148	X		X		X		X		X		X	
LOXA149	X		X		X		X		X		X	
LOXA150	X		X		X		X		X		X	
LOXA151		X	X	X	X	X	X		X	X	X	X
LOXA152		X	X	X	X	X		X	X	X	X	X
LOXA153		X	X	X	X	X	X		X	X	X	X
I-8C		X	X	X		X	X	X		X	X	
LOX04		X		X		X		X		X		X
LOX06	X		X		X		X		X		X	
LOX07	X		X		X		X		X		X	
LOX08	X		X		X		X		X		X	
LOX09	X		X		X		X		X		X	
LOX10	X		X		X		X		X		X	
LOX15	X		X		X		X		X		X	

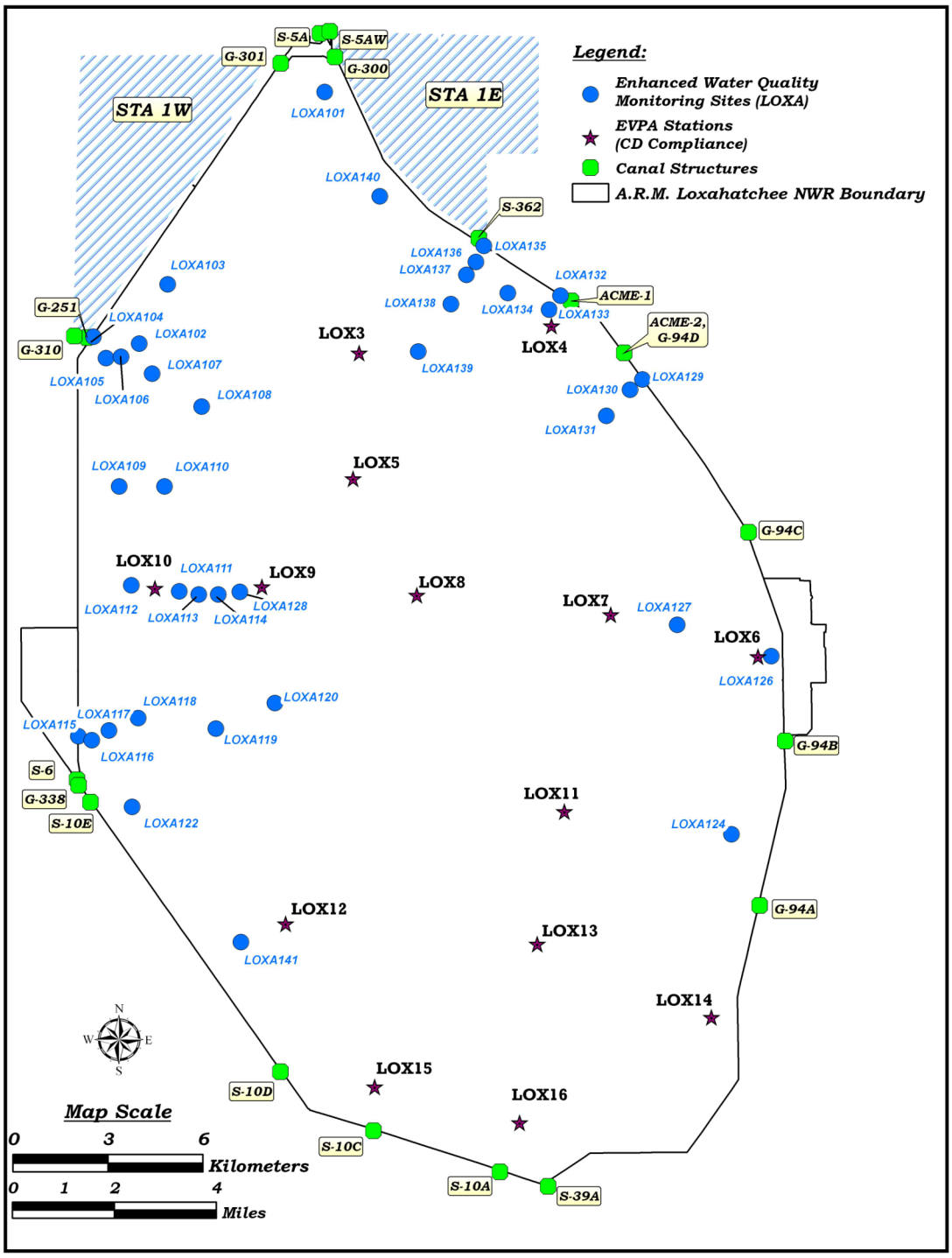

Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

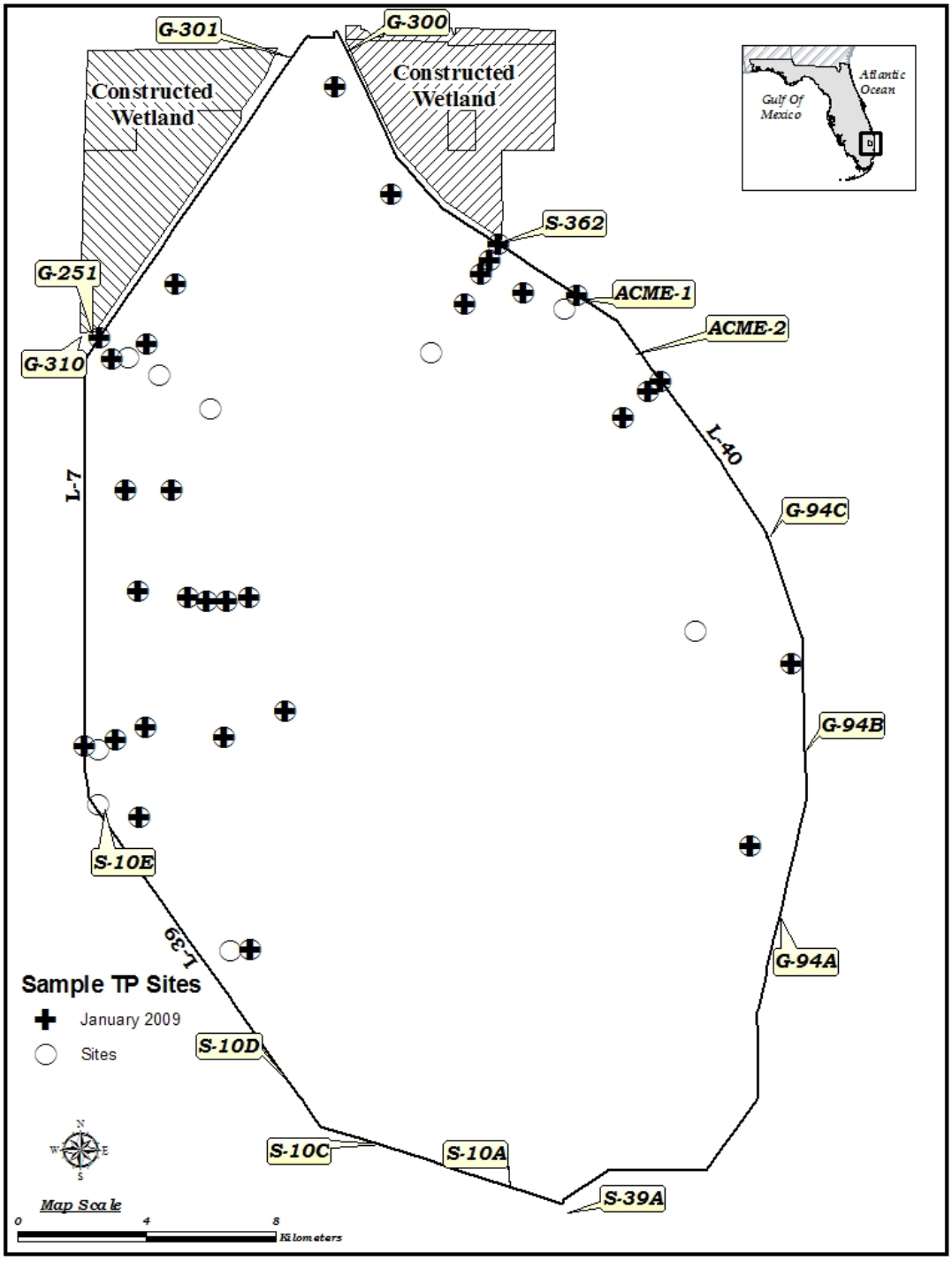

Figure 2. January 2009 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

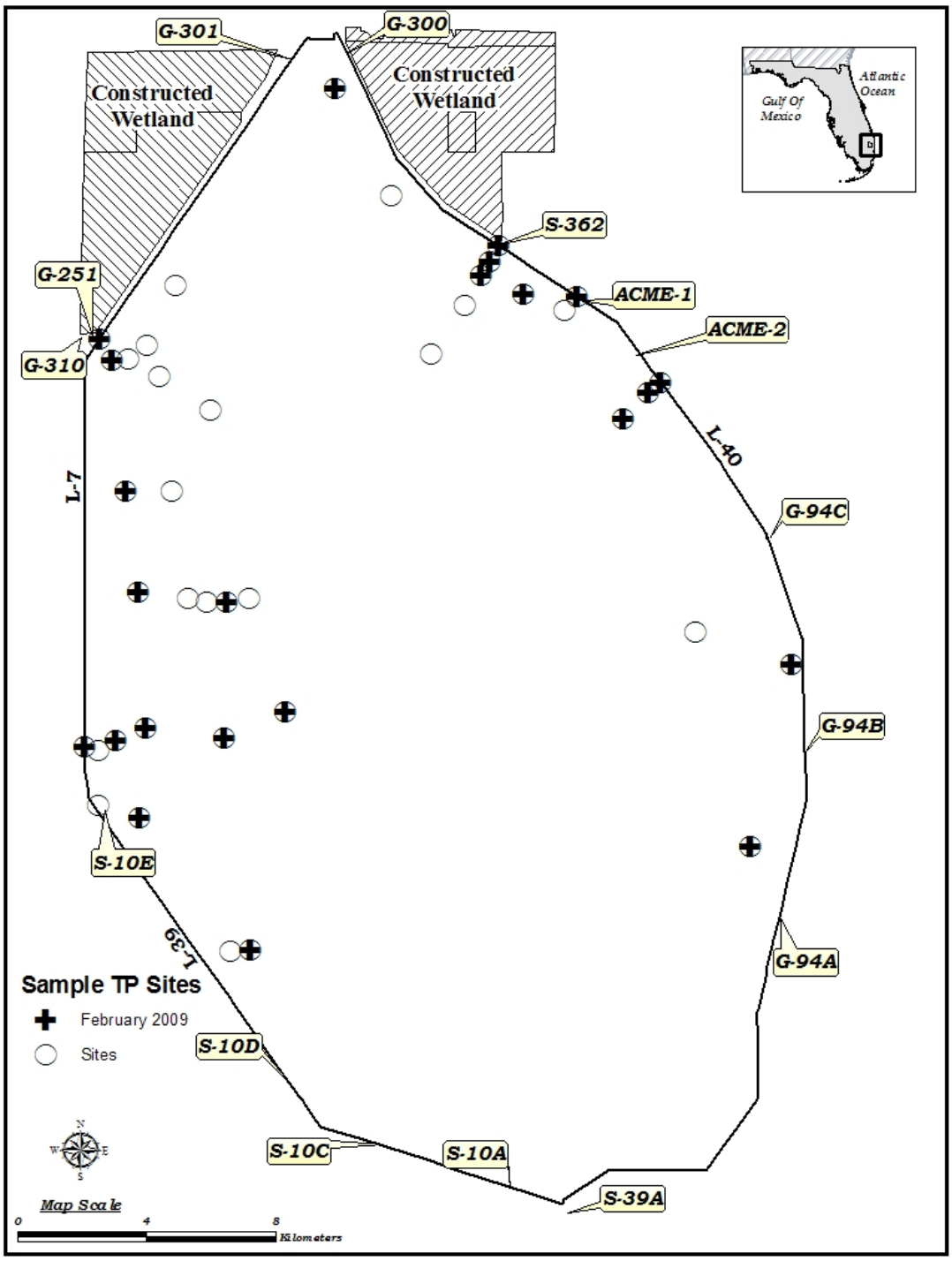

Figure 3. February 2009 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

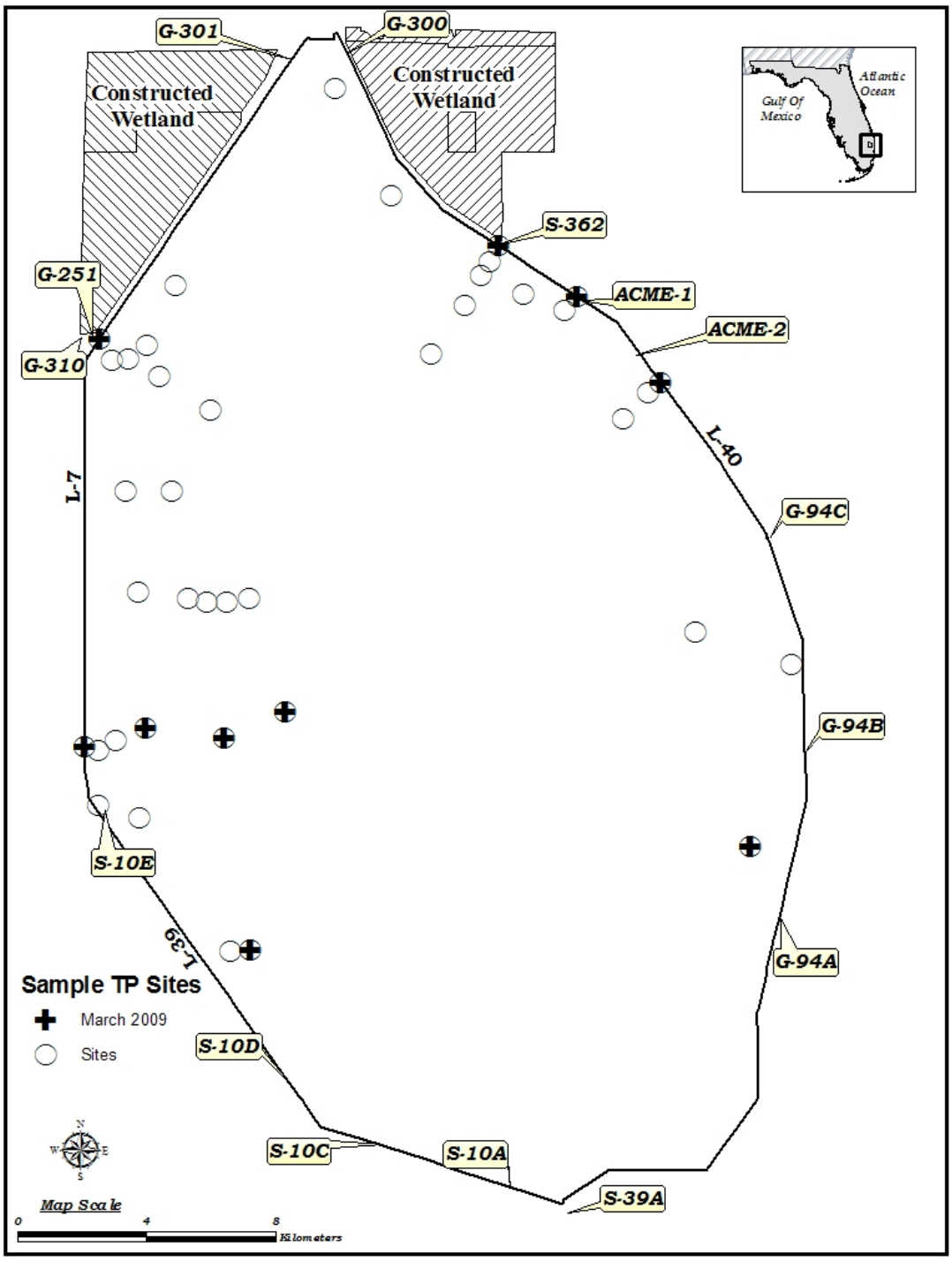

Figure 4. March 2009 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.